Terry Sample

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Northwest and Alaska Fisheries Center
Division of Resource Assessment and
Conservation Engineering
2725 Montlake Boulevard East
Seattle, WA 98112

November 23, 1976

CRUISE RESULTS

Cruise No. RP-4-MF-76-B

NOAA Ship Miller Freeman

Norton Sound and Chukchi Sea Trawl Survey

ITINERARY

The Miller Freeman departed PMC in Seattle on August 24 for Norton Sound and the Chukchi Sea and arrived in Kodiak on October 13 upon completion of the survey. Intervening port calls were made at Dutch Harbor on August 30 to embark scientists, and at Nome on September 2, 24 and October 4 to exchange scientific personnel and pick up supplies. Other port calls were made at Kotzebue on September 7 to obtain medical attention for an injured crew member and at Kivalina on September 10 to disembark a crewman.

SURVEY AREA

The general area investigated included the southeastern Chukchi Sea from the Bering Strait north to Point Hope, Kotzebue Sound, Norton Sound and the northern-most portion of the Bering Sea east of the U.S.-U.S.S.R. 1867 Convention Line and between St. Lawrence Island and Bering Strait (Figure 1).

OBJECTIVES

The primary purpose of this survey was to obtain baseline biological and environmental information to aid in establishing guidelines for future development of offshore energy resources in the region. Specifically, this survey was designed to:

1. describe the composition, distribution, and abundance of demersal and pelagic fish, shellfish, and principal invertebrate resources of Norton Sound and the southeastern Chukchi Sea during the summer-fall season by area and depth;

2. obtain information necessary to determine population parameters such as stock size, length-weight relationships, size and age compositions,

and growth rates for selected fish and invertebrate species;

3. collect stomach samples from selected species for later determination of feeding habits;

4. perform replicate demersal trawl and gillnet sets to determine possible variations between day and nighttime sampling; and,

5. collect and preserve samples of all fish species encountered for later positive identification and for collection.

In addition to the preceeding objectives, other programs operated aboard the Miller Freeman in conjunction with the trawl survey. These programs obtained information regarding marine birds and mammals, benthic invertebrates, fish and invertebrate pathology, salinity and temperature, and hydrocarbons.

GEAR

Three types of fishing gear were used during the Norton Sound-Chukchi Sea survey: an otter trawl, pelagic trawl, and gillnets. A description of the gear types are as follows:

1. The otter trawl had a 112' footrope, 83' headrope and was constructed of 4" mesh (stretched mesh measure) (#48 thread) on the wings and body and 3½" mesh (#96 thread) in the intermediate section and codend. There were 31 eight-inch diameter floats on the headrope. Other accessory gear included four 25-fathom dandylines, two connected to each wing. The codend was lined with 1¼" mesh web for the retention of small fish and invertebrates.

2. The pelagic trawl was a Mark 1 Universal type with a 121-ft. headrope and footrope. The net contained 2½" mesh web throughout the wings, body and codend. The codend was lined with 1¼" mesh web for retention of small fish. Accessory gear included six 30-fathom dandylines, three connected to each wing.

3. The gillnets consisted of a series of seven shackles of various mesh sizes connected together to form a continuous net. Each shackle was 30 to 50 fathoms long and included one of the following mesh sizes (stretched mesh measure): 0.83" (21 mm), 1.38" (35 mm), 1.65" (42 mm), 2.50" (64 mm), 3.25" (83 mm), 4.50" (114 mm), and 5.25" (133 mm). Accessory gear included marker poles and floats which were attached to each end of the net, and a radio buoy to facilitate locating the gear.

METHODS

Survey operations were conducted on a 24-hour per day basis due to the number of stations to be sampled and the short time period available for their examination.

The survey area was divided into 4 sub-areas (Figure 1). Demersal trawling densities in these sub-areas were established on the basis of potential environmental impact from oil development and other factors relating to this region. Shallower inshore stations (sub-areas B and D), with subsequently greater risk potentials, had the highest density (1 station/100 nautical miles^2). The offshore region (sub-areas A and C), where the risk is lower, had a sampling density of 1 station/225 nautical miles^2.

In addition, the survey region was divided in two otolith areas so that possible differences in growth rates north and south of the Bering Strait could be examined.

A 30-minute demersal trawl haul was made at each scheduled station. Upon completion of the tow, the catch was brought aboard, sorted and examined for species composition by weight and number. Biological information was obtained for the principal fish and shellfish species encountered. These data included: size and sex composition, age determination and stomach samples for selected species, and shell and egg condition for commercially important crab species.

During trawling operations and travel between stations, the water column was monitored with acoustical sounders to locate off-bottom fish. When off-bottom fish signs were encountered a pelagic tow was conducted. Set locations are given in Figure 2.

A series of gillnet sets were conducted throughout the survey area (Figure 2) to qualitatively sample near-surface fish species. The gillnets were set after sunset and generally allowed to soak for 8 to 10 hours. Locations of these sets were contingent on progress along daily cruise tracks and were made near demersal stations scheduled to be completed at night.

Replicate demersal trawls and gillnet sets were conducted at several locations to determine temporal changes in species composition and density, and establish whether significant catch rate differences resulted between day and nighttime fishing. These replicate stations included a minimum of 4 day and 4 nighttime 30-minute trawl hauls and a series of 4 gillnet sets. The gillnet sets included an 8 to 10 hour evening set and three daytime sets of 2, 4, and 8 hours duration.

RESULTS

1. Data collected

During the 34 non-transit vessel working days in the Chukchi Sea-Norton Sound survey area, 249 trawl hauls were made, including 8 pelagic and 44 replicate demersal tows (Figure 3). A total of 25 of the scheduled 240 demersal trawl stations were found to be untrawlable due to rough bottom. All other stations were either successfully occupied or west of the continental shelf median line.[1/] Thirty-three (33) gillnet sets also were performed.

1/ A boundary established by the 1958 International Convention of the Continental Shelf for dividing shelf areas adjacent to two territories, in this instance, between the U.S. and U.S.S.R.

Nearly 46,000 length measurements for use in establishing size composition were obtained from the following fish species:

Species	Number measured
Saffron cod (Elginus gracilis)	23,008
Arctic cod (Boreogadus saida)	3,722
Walleye pollock (Theragra chalcogramma)	359
Yellowfin sole (Limanda aspera)	6,002
Alaska plaice (Pleuronectes quadrituberculatus)	1,520
Starry flounder (Platichthys stellatus)	1,140
Bering flounder (Hippoglossoides robustus)	137
Longhead dab (Limanda proboscidea)	56
Arctic flounder (Liopsetta gracialis)	45
Rainbow (toothed) smelt (Osmerus mordax dentax)	5,766
Pacific herring (Clupea harengus pallasi)	2,972
Capelin (Mallotus villosus)	

Furthermore, length measurements were also taken from less frequently encountered species.

Independent length-weight-age information was collected on 6 species from the two otolith areas of the survey. Approximately 1,850 length-weight measurements and otoliths were taken for the following species by region:

Species	North otolith area	South otolith area	Total
Saffron cod (Eliginus gracilis)	184	254	438
Pacific herring (Clupea harengus pallasi)	147	146	293
Yellowfin sole (Limanda aspera)	197	108	305
Rainbow (toothed) smelt (Osmerus mordax dentax)	152	55	207
Alaska palice (Pleuronectes quadrituberculatus)	209	94	303
Arctic cod (Boreogadus saida)	142	161	303

Ninety-seven (97) stomach samples were collected from saffron cod (Eliginus gracilis) and rainbow (toothed) smelt (Osmerus mordax dentax). These stomachs were preserved in a formalin solution for subsequent analysis.

Approximately 50 tentatively identified fish species were encountered during the cruise (Table 1). Representatives of all species were frozen for later conformation of field identification. Additionally, nearly 700 fish, comprising 29 species, were preserved in a 10% formalin solution to furnish samples previously requested by the Smithsonian Institute.

Various species of snails were taken during the cruise. A total of 5,236 of the 16,366 individuals collected were preserved for laboratory examination.

2. Preliminary findings

Demersal

In general, demersal fish catches were small throughout the entire survey area averaging less than 100 pounds per 30 minute trawl haul. The shallower inshore areas were found to be more productive than deeper offshore waters. Average size of several fish and shellfish species taken in the survey region was noticeably smaller than sizes associated with eastern Bering Sea stocks of the same species.

Representatives of the families Gadidae, Pleuronectidae, Osmeridae, Clupeidae, and Cottidae were the most commonly encountered fish fauna. Other less frequently taken families included Agonidae, Cyclopteridae, Zoarcidae, and Stichaeidae. Species composition generally did not vary between areas. Tables 2 and 3 summarize some preliminary catch findings by area and depth.

The Gadids represented a major portion of the catches. Arctic cod (Boreogadus saida) was the most common species in the Chukchi Sea and Kotzebue Sound, and their occurrence increased with depth. Saffron cod was the predominant species in the Norton Sound and had the largest average catch per trawl haul. They were, however, less frequently taken in the Chukchi Sea area.

Juvenile saffron cod were generally found to be restricted to the shallows in both areas. They occurred most frequently at depths of 0-25 meters and their density generally decreased with an increase in depth. Both percent occurrence and average weight caught, by depth, were greater in the Norton Sound region than in the Chukchi Sea.

The most frequently encountered Pleuronectid was Alaska plaice (Pleuronectes quadrituberculatus). Starry flounder (Platichthys stellatus) and yellowfin sole (Limanda aspera) also were frequently encountered, and were more commonly taken in the Norton Sound region than the Chukchi Sea. Both starry flounder and yellowfin sole appeared to be restricted to the shallower waters. Their incidence of occurrence and average catch weights dropped sharply with increased depths. Neither species were taken in waters over 50 meters.

Other frequently encountered fish species included rainbow smelt and Pacific herring (Clupea harengus pallasi). Smelt had approximately the same average catch weight in both areas but were more frequently encountered in the Norton Sound region. Conversely, Pacific herring were more common and had a greater catch rate in the Chukchi Sea than in the Norton Sound region.

Cottids were abundant throughout the entire survey area, being represented in nearly all demersal trawl hauls. The plain sculpin (Myoxocephalus joak), shorthorn sculpin (Myoxocephalus scorpius), antlered sculpin (Enophrys

claviger) and Gymnocanthus sp. were the cottids most commonly encountered.

Commercially important invertebrate species encountered during the survey included Tanner crab (Chionoecetes opilio), two species of king crab (Paralithodes camtschatica and P. platypus) and several species of snails.

Chionoecetes opilio was the most commonly observed crab species throughout the survey area with the percent of occurrence increasing with depth. Generally, the catches consisted of juveniles with relatively few mature adults taken. Average catches by weight were much greater in the Chukchi Sea than in Norton Sound areas. Both species of king crab were present in both areas, but in much smaller numbers than C. opilio.

Snails were widespread in occurrence. The major species encountered included Neptunea heros, N. ventricosa, N. borealis, Beringius beringii, and Pyrulofusus deformis.

Gillnet and Pelagic

Gillnet operations proved to be very unproductive. Catches were small, ranging from approximately 55 fish to no catch. Sets made at inshore areas usually caught more than those made in offshore waters. Most fish were taken in the smaller mesh sizes with Pacific herring and rainbow smelt being the most common. Other species taken in gillnets included: arctic char (Salvelinus alpinus), pink salmon (Oncorhynchus gorbuscha), and chum salmon (Oncorhynchus keta).

Pelagic trawl hauls were conducted on a random basis during the entire survey because no extensive off-bottom fish concentrations were encountered. Time limitations and equipment malfunctions restricted pelagic trawl operations. Catches were small and provided limited qualitative information. The largest pelagic trawl catch (15 fish) occurred near the entrance of Kotzebue Sound and included: rainbow smelt, saffron cod, arctic char, and juvenile pink salmon.

Scientific Personnel

Leg I 8/30/76 - 9/24/76

Robert J. Wolotira, Jr., NWAFC, NMFS, Chief Scientist	8/30-9/24
Martin Morin, Jr., NWAFC, NMFS, Demersal	8/30-9/24
William Gronlund, NWAFC, NMFS, Pathology	8/30-9/24
Kate King, NWAFC, NMFS, Pathology	8/30-9/24
Sandy Wakefield, NWAFC, NMFS, Demersal	8/30-9/24
Roland McBride, NWAFC, NMFS, Demersal	8/30-9/24
Steve Jewett, IMS/UA, Benthos	9/02-9/24
Max Hoberg, IMS/UA, Benthos	9/02-9/24
Louis Barton, ADF&G, Pelagic	8/30-9/08
Ray Baxter, ADF&G, Pelagic	9/08-9/24
Pat Baird, USF&WS, Birds	8/24-9/02

Leg II 9/27/76 - 10/13/76

Norman Parks, NWAFC, NMFS, Chief Scientist	9/27-10/13
Terry Sample, NWAFC, NMFS, Demersal	9/27-10/13
William Gronlund, NWAFC, NMFS, Pathology	9/27-10/13
Kate King, NWAFC, NMFS, Pathology	9/27-10/13
Rich MacIntosh, NWAFC, NMFS, Demersal	9/27-10/13
Nikki Newcome, NWAFC, NMFS, Demersal	9/27-10/13
Kathy Frost, ADF&G, Marine Mammals	9/27-10/13
Don Seagren, ADF&G, Pelagic	9/27-10/13
Max Hobert, IMS/UA, Benthos	9/27-10/13
John Hilsinger, IMS/UA, Benthos	9/27-10/13

Table 1.--List of fish species tentatively identified from catches made during the Miller Freeman Cruise MF-76-B.

Scientific Name	Common Name
Agonus acipenserinus	Sturgeon poacher
Aspidophoroides olriki	Arctic alligatorfish
Ocella verrucosa	Warty poacher
Ammodytes hexapterus	Pacific sandlance
Anarchichas orientalis	Bering wolffish
Clupea harengus pallasi	Pacific herring
Artediellus scaber	Hamecon
Enophrys clariger	
Gymnocanthus galeatus	Armorhead sculpin
Gymnocanthus tricuspus	Arctic staghorn sculpin
Hemilepidotus hemilepidotus	Red Irish lord
Hemilepidotus jordani	Yellow Irish lord
Megalocottus platycephalus	Belligerent sculpin
Myoxocephalus joak	Plain sculpin
Myoxocephalus quadricornis	Fourhorn sculpin
Myoxocephalus scorpius	Shorthorn sculpin
Nautichichthys pribilovius	Eyeshade sculpin
Psychrolutes paradoxus	Tadpole sculpin
Triglops pingeli	Ribbed sculpin
Eumicrotremus orbis	Pacific spiny lumpsucker
Liparis sp.	
Boreogadus saida	Arctic cod
Eleginus gracilis	Saffron cod
Theragra chalcogramma	Walleye pollock
Pungitius pungitius	Ninespine stickleback
Hexagrammos stelleri	White-spotted greenling
Mallotus villosus	Capelin
Osmerus mordax dentex	Rainbow smelt
Hypomesus olidus	Pond smelt
Hippoglossoides robustus	Bering flounder
Hippoglossus stenolepis	Pacific halibut
Limanda aspera	Yellowfin sole
Limanda proboscidea	Longhead dab
Liopsetta glacialis	Arctic flounder
Platichthys stellatus	Starry flounder
Pleuronectes quadrituberculatus	Alaska plaice
Reinhardtius hippoglossoides	Greenland halibut
Coregonus laurettae	Bering cisco
Oncorhynchus gorbuscha	Pink salmon
Oncorhynchus keta	Chum salmon
Oncorhynchus tshawytscha	Chinook salmon
Salvelinus alpinus	Arctic char
Chirolophis polyactocephalus	Decorated warbonnet
Eumesogrammus praecisus	Fourline snakeblenny
Lumpenus fabricii	Slender eelblenny

Table 1.--cont.

Lumpenus mackoyi	
Stichaeus punctatus	
Gymelis viridus	Fish doctor
Lycodes concolor	
Lycodes turneri	Polar eelpout

Table 2.--Catch rates (pounds per trawl haul) by area and depth interval for principal fish and shellfish species taken during Miller Freeman Cruise MF-76-B.

	CHUKCHI SEA AREA DEPTH (meters)				NORTON SOUND AREA DEPTH (meters)			
	0-25	26-50	>50	Total[1/]	0-25	26-50	>50	Total[1/]
Saffron cod (juv.)	0.5	0.8	0.01	0.6	7.8	3.3	<0.1	5.5
Saffron cod (adult)	1.6	4.0	--	2.6	31.1	17.6	--	23.7
Arctic cod	0.3	3.5	1.2	2.0	1.7	1.3	--	1.5
Yellowfin sole	1.2	0.2	--	0.5	4.0	0.7	--	2.5
Alaska plaice	2.1	0.8	--	1.1	6.2	1.2	<0.1	1.8
Starry flounder	2.5	2.6	--	2.2	26.3	5.0	--	7.6
Toothed smelt	1.2	2.5	--	1.7	1.3	1.7	--	1.4
Herring	2.6	8.7	--	5.4	0.8	0.9	--	0.8
Tanner crab	5.7	25.3	12.0	16.3	<0.1	3.6	3.5	1.7
King crab (camtschatica)	0.2	0.1	--	0.1	9.3	6.2	--	7.5
King crab (platypus)	--	0.3	--	0.1	--	2.5	6.1	1.4
Snail spp.	12.5	21.5	25.5	18.9	13.2	15.2	4.0	13.5

1/ Replicates and gillnets not included.

Table 3.--Percent occurrence by area and depth interval for principal fish and shellfish species taken during Miller Freeman Cruise MF-76- .

	CHUKCHI SEA AREA DEPTH (meters)				NORTON SOUND AREA DEPTH (meters)			
	0-25	26-50	50	Total[1/]	0-25	26-50	50	Total[1/]
Saffron cod (juv.)	69%	29%	10%	40%	78%	42%	0%	58%
Saffron cod (adult)	77	42	--	49	100	73	100	89
Arctic cod	65	87	100	81	86	83	--	79
Yellowfin sole	77	24	--	39	92	42	--	66
Alaska plaice	88	74	--	69	89	50	14	68
Starry flounder	54	21	--	30	78	35	--	55
Toothed smelt	77	58	--	57	86	62	--	71
Herring	65	61	--	54	48	50	--	38
Tanner crab	62	92	100	82	23	85	100	53
King crab (camtschatica)	1	5	--	3	66	25	--	45
King crab (platypus)	--	5	--	3	--	35	71	19
Snail spp.	69	85	90	78	63	94	100	78

1/ Replicates and gillnets not included.

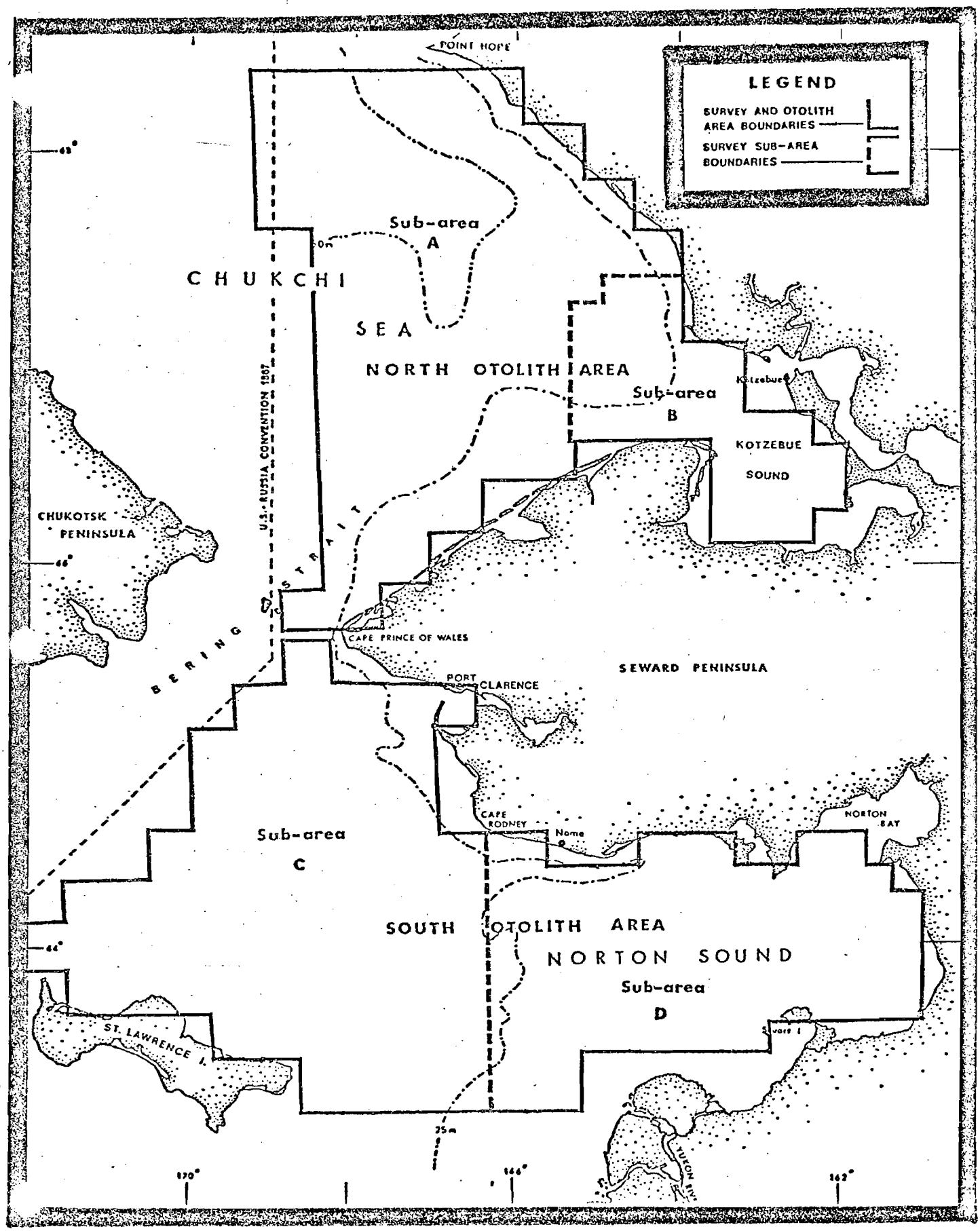

Figure 1.--Survey, sub-area and otolith area boundaries for Miller Freeman Cruise MF-76-B.

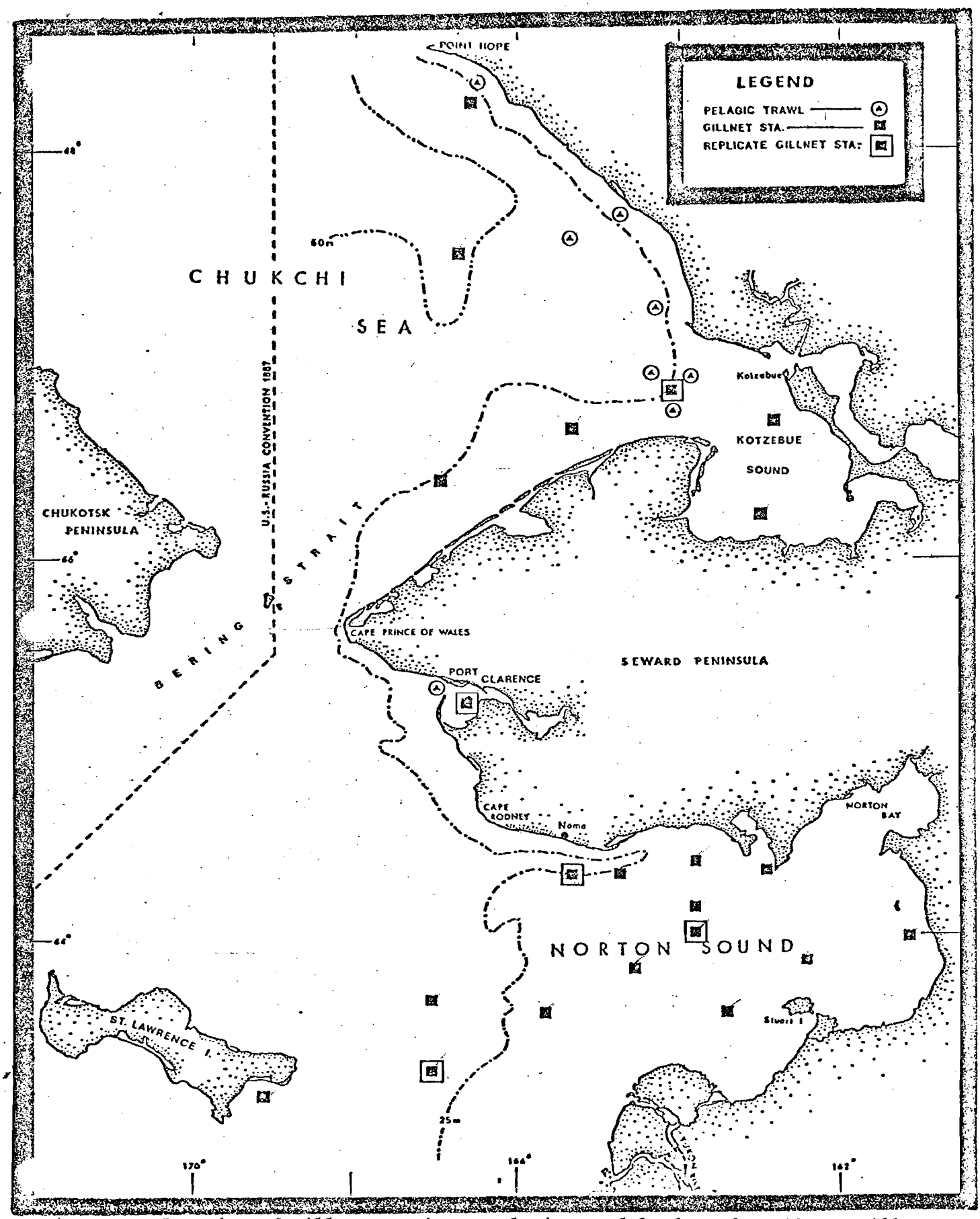

Figure 2.--Location of gillnet stations, pelagic trawl hauls and replicate gillnet sites during Miller Freeman Cruise MF-76-B.

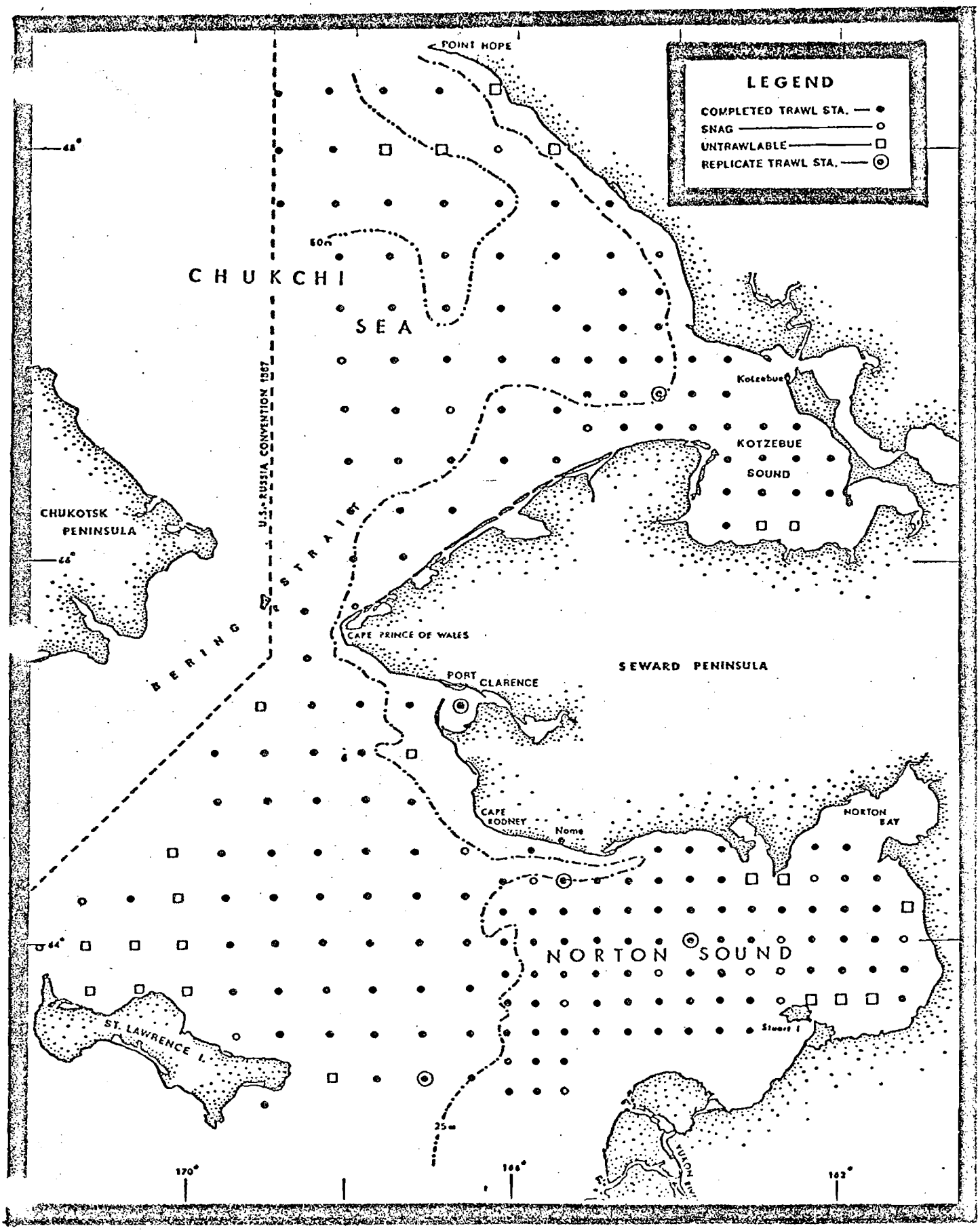

Figure 3.--Demersal trawl stations examined during Miller Freeman Cruise MF-76-B.